Director of Central Intelligence Postdoctoral Research Fellowship Program

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1. INTRODUCTION

The Director of Central Intelligence (DCI) has established a Postdoctoral Research Fellowship Program within the CIA's Directorate of Science and Technologies (DS&T), Chief Scientist Staff. The DCI Postdoctoral Research Fellowship Program was created in response to the Intelligence Community (IC) requirement to address long-term research and technology needs that will meet the goals and mission of the IC. The Postdoctoral Research Fellowship Program will provide the IC an outreach opportunity into centers of expertise in academia and national laboratories and help to engage fully with experts outside of the Intelligence Community. As the role of science and technology becomes an increasingly critical driver of global developments, the DCI Postdoctoral Research Fellowship Program will focus on research in leading edge technologies supporting broad Intelligence Community technology needs.

The National Geospatial Intelligence Agency (NGA's) InnoVision Directorate will act as an executive agent for the university-based segment of the DCI Postdoctoral Research Fellowship Program. NGA's role as executive agent includes posting this Broad Agency Announcement, managing the proposal review process and using its grant authority to make awards in the program.

2. GENERAL INFORMATION

The Director of Central Intelligence (DCI) and the DS&T's Chief Scientist announce a Fiscal Year 2004 competition for the DCI Postdoctoral Research Fellowship Program.

The mission of the DCI Postdoctoral Research Fellowship Program is to establish long-term relationships and mentoring of postdoctoral researchers and to provide research institutes with an understanding of the Intelligence Community's research requirements. The program will foster partnerships with postdoctoral researchers as they move into career positions and provide innovative solutions to critical Intelligence Community problems.

The primary goals of this program are to:

- Build positive relationships with postdoctoral researchers presently and as they move into career positions;
- Establish one to three year alliances with Postdoctoral Fellows through competitive grants with universities, private research institutes and national laboratories;

- Provide the Intelligence Community access to advanced research in science and technology through a postdoctoral research program;
- Identify new sources of research applicable to the Intelligence Community's mission and solve critical Intelligence Community problems in innovative ways; and
- Provide a pool of researchers capable of supporting future Intelligence Community needs.

Through this competition, the Chief Scientist (CS) expects to make awards in specific research topics. All awards will be based on merit competition. Depending on the quantity and quality of proposals received, the CS may not make any award(s) under a particular research topic. In the event more funds become available additional awards maybe made at a later date based on initial evaluation results. Typically each award will be:

- For a basic period of one year (funded incrementally), with a potential option for a second and third year, and
- For the amount of $120,000 per year/per grant.

This DCI Postdoctoral Research Fellowship Program competition is specifically for the research topics described in paragraph 8. Offerors are advised to read this announcement carefully. It explains the program research needs upon which the topics are based and the terms and conditions of this competition.

3. AREAS OF INTEREST

In paragraph 8, this BAA describes twenty-four (24) research areas, comprising some of the Intelligence Community's most current technology interests. These descriptions provide offerors with a frame of reference. The DCI encourages innovative ideas that address these interests. Offerors are urged to consider the research issues posed and, as appropriate, to contact our research topic chiefs to discuss potential efforts. Inquiries are welcome. Note that while technical contacts are listed for a topic, proposals must be submitted only to the addressees shown in paragraph 5.2.

4. CONDITIONS

The DCI expects that DCI Postdoctoral Research Fellowship Program projects will promote application of research primarily for intelligence purposes. The first phase of this competition has been completed. An internal program call was placed – at the National Foreign Intelligence Program (NFIP) agencies: CIA, NGA, NRO, NSA and DIA (including NGIC, NAIC, AFMIC, CMO and others) – for federal NFIP employees interested in making a commitment to serve as an Intelligence Community advisor (mentor) for a minimum of two years. Intelligence Community

advisors submitted their resumes as well as proposed research topics that would help to draw highly qualified Postdoctoral Fellows for Intelligence Community-related research. These research topics are listed in paragraph 8.

With completion of the first phase, the call in this announcement is seeking qualified postdoctoral research investigators interested in being funded to support research in the specified topical areas and to support interactions with the Intelligence Community advisors.

Potential Fellows must be associated with an accredited U.S. university or college. **Each Postdoctoral Fellow must be a U.S. citizen.** The principal investigator / university mentor, is **NOT** required to be an U.S. Citizen.

5. SUBMISSION HIGHLIGHTS

The Government will evaluate all proposals submitted under the terms and conditions of this BAA. Government-paid consultants or subject matter experts may be involved in the evaluation and selection processes.

5.1. General

The CS, through NGA as his executive agent, intends to make awards with FY04 funding. To be considered and evaluated the Government must receive the full proposal by the due time and date identified in paragraph 9.

NGA will send the offeror an acknowledgment of receipt of the submission, and will follow-up later with a notification letter announcing whether the proposal is being recommended for an award. Acknowledgment and notification will be sent to the principal investigator via e-mail, according to the schedule in paragraph 9, with a copy to the appropriate university administrative office.

Proposals will be evaluated against criteria described in paragraph 6.1. The estimated grant start date identified in paragraph 9 should be used for budget and proposal purposes. **You may, however, request a later start date and may therefore develop your budget based on your proposed start date.**

5.2. Submission

Proposals shall be formatted as one .doc file (or "zipped".doc file) of a size not to exceed 1.95 Megabytes in total. The Government's mail servers will not accept files of a greater size. The proposal shall reference BAA Number HM1582-04-BAA-0001. Proposals shall be submitted electronically by e-mail and to prfp04@westfields.net.

5.3. Content

Proposals must be complete and self-contained to qualify for review. Proposals shall be prepared single-spaced in 12-point Times New Roman font, with at least one-inch margins on top, bottom and sides, on 8½" by 11" paper.

The Intelligence Community is concerned with research in specific areas of science and engineering. For this reason, all proposals must adequately describe the technical objectives and approaches, support of principal investigator and Postdoctoral Fellow, and expenditures for equipment, all of which will be evaluated by qualified reviewers per paragraph 6.2. Separate attachments, such as institutional brochures or reprints that are not germane to the proposal, are discouraged.

The proposal shall include all of the following items.

5.3.1. Cover Page

The cover page shall include the BAA number HM1582-04-BAA-0001, proposal title, and topic or research area of interest**. The cover page must also indicate the name, phone number, fax number, postal address, and e-mail address of both the principal investigator AND an appropriate official in the university's research administration office.**

5.3.2. Project Description

The project description portion of the proposal shall be limited to three pages and shall:

A. Describe the proposed research objectives and approach to be undertaken. State the objectives and approach and the relationship to state-of-knowledge in the field and to similar work in progress. Include appropriate literature citations and prior work. Discuss the nature of expected results.

B. Describe the expected outcomes and relevance to the Intelligence Community research need.

C. Identify other parties to whom the proposal has been/will be sent.

5.3.3. Resume

The Resume shall be limited to two (2) pages each and shall provide the credentials of the principal investigator, demonstrating why the offeror is

qualified to do the work proposed. If a Postdoctoral Fellow has been identified, an additional resume, two (2) pages in length, may also be included. All requests for Government Furnished Data shall be included in the proposal. Any Government Furnished Data that may be provided will be provided with GOVERNMENT PURPOSE DATA RIGHTS.

5.3.4. Cost

Beginning on a new page, the financial portion of the proposal should contain cost estimates in sufficient detail for meaningful review. The annual cost must be no greater than $120,000. At least 50% of this cost should be allocated for direct support of one full-time Postdoctoral Fellow, including salary and fringe benefits. The remaining funds can be allocated to a fraction of the principal investigator's time, unique equipment needed to conduct the proposed research, other direct costs. University overhead will not exceed 10% of total proposal cost. For proposal purposes, use the later of the estimated award start date per paragraph 9 or the offeror's proposed start date. Exceptions to the above-recommended allocation will need to be approved by the Chief Scientist. The cost proposal must include the total cost of the project, as well as a breakdown of the amounts by source of funding (e.g., funds requested from the DCI Postdoctoral Research Fellowship Program, and/or institutional funds to be provided as cost sharing). The costs should be broken down for each year of the program and shown by three distinct totals: a total for the basic year and a total for each of the optional follow-on years. Although expected to be short, there is no page limit for the cost section of the proposal. Cost elements should include, but are not limited to:

A. Time being charged to the project by the principal investigator and Postdoctoral Fellow, and their commensurate salaries and benefits.

B. Costs of equipment based on most recent quotations and broken down in sufficient detail for evaluation (equipment costs should be budgeted primarily during the first year). Allowable equipment will ordinarily be limited to research equipment and apparatus not already available for the conduct of the work. General-purpose equipment, such as a personal computer, is not eligible for support unless primarily used in the actual conduct of the proposed scientific research.

C. Travel costs and time, and the relevance to stated objectives. **This shall include a breakdown of the name and number of travelers, location and duration; and estimated costs for transportation, rental car and per-diem.** This shall also include travel for the

required attendance at the annual DCI Postdoctoral Research Fellowship Program colloquium in the spring of each year. The colloquium is held in the Washington D.C. area.

D. Other direct costs such as materials and supplies; publication, documentation and dissemination; computer services; communication costs not included in overhead; or others (identify). These costs shall include at least one published article per year in the Journal of Intelligence Community Research and Development (JICRD). This published article will need to be coordinated, vetted and submitted through the IC Advisor.

E. Indirect costs.

5.3.5. Certifications

By signing and submitting any proposal under this BAA, the offeror is providing the:

A. Certification at Appendix A to 32 CFR Part 25 regarding debarment, suspension, and other responsibility matters;

B. Certification at Appendix C to 32 CFR Part 25 regarding drug-free workplace requirements; and

C. Certification at Appendix A to 32 CFR Part 28 regarding lobbying.

D. A SF 424 will be requested from all awardees and shall be submitted prior to award.

These certifications are located in Parts 25 and 28 of the DoD Grant and Agreement Regulation (DoDGARs), D0D 3210.6-R. This document is available electronically, under the heading "publications", at the following Internet site: http://www.dtic.mil/whs/directives/.

The person who is authorized to provide these certifications should sign the proposal. Proposals submitted without signatures shall require a separate execution of the certifications. Also, it will be necessary for either the Dean or Provost at the University to acknowledge that they are receiving CIA Funds.

6. EVALUATION CRITERIA AND SELECTION PROCESS

6.1. Criteria

6.1.1 The initial evaluation criteria, used to determine if an offer is "selectable", are:

A. The qualifications of the principal investigator and Postdoctoral Fellow (50%);

B. Scientific and technical merits of the proposed research (30%), and

C. Relevance and potential contributions of the research to the Intelligence Community's missions (20%);

D. The realism and reasonableness of cost, including proposed cost sharing. Evaluation of cost shall be based on cost realism as it relates to the Government's degree of confidence in the offeror's ability to perform the proposed work at the proposed cost. This criterion will be evaluated as pass/fail.

6.1.2 The final evaluation criteria are:

A. The numerical score from the "selectable" evaluation.

B. The potential contribution to the advancement of the targeted technical topic(s).

C. The amount of similar or related research already underway on a given topic.

6.2. Proposal Evaluation Process

The Intelligence Community Advisors will independently review the proposals, evaluating them in accordance with all the evaluation criteria of paragraph 6.1.1 of this document, and completing a set of Evaluation Worksheets for each proposal. Proposals will be grouped together by specific research area. One expert team will evaluate all proposals in the same group. Out of all the proposals evaluated in the same group, the expert team will prioritize and recommend one or more proposals as they determine to be "selectable."

Next, all the recommended selectable proposals will be discussed by an Evaluation Panel consisting of the five NFIP agency points of contact, the NGA executive agent and the DCI Postdoctoral Research Fellowship Program Manager. The panel anticipates to award two grants to each NFIP agency (CIA, NGA, NRO, NSA,

DIA). The panel will convene and will use the criteria of paragraph 6.1.2 to consider the overall contribution of each 'selectable' proposal as reflected by the numerical score, the potential contribution to the advancement of the targeted technical topic(s), and the amount of similar or related research already underway on a given topic. The panel will also consider the amount of available funding. This step brings a cross-discipline balance to the selection process, reconciles recommendations about proposals spanning more than one technical area, and allows for strategic consideration of the diversity of proposals across the topic areas. While it is the panel's intent to make two awards on behalf of each of the five NFIP agencies, the final outcome may not reflect this intent. In summary, the combination of 'selectable' proposals that most effectively advances NFIP's academic research program will be recommended for award. The number of awards made is dependent upon the amount of available funding. If added funding becomes available from within the community or from other U.S. Government agencies, the program may choose to make additional awards under the terms of this BAA from the remaining selectable proposals. The sponsoring organization will be free to support any 'selectable' proposal(s) that addresses the research interests of that organization.

The list of proposals recommended for award, along with a description and results of the evaluation process, will be forwarded to the Director of Intelligence Technology Innovation Center (ITIC) for approval. When approved, the award list will be forwarded to the Contracting Officer for award action, to include as necessary, cost analysis and contract negotiation. Awards will be made upon successful negotiation.

7. AWARDS

Awards will be made for one year with two one-year options. The Government expects to exercise the first year option assuming quality research is ongoing. Second year option will be the exception, rather than the rule. The awards will be incrementally funded at funding levels no greater than $120,000 per year, per award/option period.

Notification announcing whether or not the offeror's proposal is being recommended for an award will be e-mailed directly to the principal investigator. Awards are expected to be in place by the proposed start date or the start date identified in paragraph 9, whichever is later.

Once a proposal is selected for award, one of two scenarios will be executed:

A. If a postdoctoral candidate is already identified and prepared to begin the proposed research, 100% of the first year's award funding could be provided by the start date.

B. If a qualified postdoctoral candidate must be sought, $10,000 of the award amount will be provided initially, with the remaining first year's funding provided when the qualified candidate is identified and selected by the university.

8. SPECIFIC RESEARCH TOPICS FOR FY03 DCI POSTDOCTORAL RESEARCH FELLOWSHIP PROGRAM

The following 2 topics represent the Intelligence Community's research interests particularly suited this year for investment. An award in any topical area will be made only if a sufficiently meritorious proposal is received. The CS reserves the right to allocate available funds among topics based on the quality of the responses and priorities. Following are the titles of the proposed research topics with the agency having primary interest in each topic shown in parentheses after the title. A detailed description of each topic with Point of Contact (POC) data is presented in following paragraphs.

1. Wireless Self-Organizing Network Research (CIA)
2. Mass Communication Research for Detecting and Analyzing Hostile Media Campaigns (CIA)
3. 3D Models from Uncontrolled Video (CIA)
4. Improved Compact Energy Storage and Power Generation Devices (CIA)
5. Remote Sensing of Concrete Properties (CIA)
6. Full Spectrum Methods and Techniques (NGA)
7. Biological Principles applied to Geospatial Intelligence Data Fusion (NGA)
8. Handwritten Document Image Processing (NSA)
9. Nanostructural Photonics (NSA)
10. Quantum Key Distribution (NSA)
11. Statistical Structure of the Ionosphere (NRO)
12. (Topic withdrawn)
13. Meta-materials for Antennas -GD- (ITIC)
14. Nanotubes and Organic Conductors for High-Performance –MC- (ITIC)
15. Fluorescent nano-particles for high efficiency sensors –MC- (ITIC)
16. Organic Electronic Transport in Confined Dimensions –MC- (ITIC)
17. Nano- to Micro-Scale Power Sources –MC- (ITIC)

18. Discovering pathogen signatures of genetic modification associated with virulence factors, toxins, and antibiotic resistance -RW- (ITIC)
19. Improving the Ease of Use of Iris Recognition Biometric Systems –AK- (ITIC)
20. How Can Condition-Based Maintenance Teach Us How to Build More Robust Robots– GM- (ITIC)
21. Countering Pathogen Virulence - NK - (ITIC)
22. Inversion of Undersampled, Noisy, Ambiguous Data" Selection and Qualification of Concluding Hypotheses –DC- (ITIC)
23. Cross-Domain Monitoring of Activities of Non-State Individuals and Organizations – SD- (ITIC)
24. Novel Applications of Quantum Entangled Photons for the Information Gathering – SD- (ITIC)

8.1. Wireless Self-Organizing Network Research

POC: Mr. Peter Hendrickson, 703-874-0658 (CIA)

Networked microsensors technology will have a significant impact on intelligence community (IC) missions. Small and inexpensive energy-efficient processors with onboard sensors, networked through self-organizing wireless links, deployed in large numbers will provide unprecedented opportunities for reconnaissance and surveillance, as well as other tactical applications.

Such microsensors can be deployed on the ground, in the air, in vehicles, and inside buildings to detect and track threats. Each microsensor node will have embedded processing capability, one or more onboard sensors, geographic position ability through global positioning systems (GPSs) or local positioning methods, and short-range wireless communications. Such communications will facilitate the deployment and adaptation of stationary and mobile ad-hoc networks, those networks that deploy and maintain themselves with no planned connectivity or fixed routing scheme.

The development of new wireless ad-hoc microsensor networks will require advances in technology from four different research areas: sensing, communication, microelectronics, and computing (including hardware, software, and algorithms). We are interested in proposals that

provide insight into the practical advantages of existing or new technologies in these areas, with due consideration given to the advantages that accrue from the application of the proposed technologies over those used in emerging commercial and military wireless self-organizing network concepts [1].

High-priority ad-hoc networked microsensors technology areas of general interest for the IC, that have high potential to improve and/or enable new IC applications, include:

- evolution and convergence of microelectronic communication circuits and microelectromechanical sensors to enable hardware miniaturization (less than a few cubic millimeters) in power-efficient sensing, computing, and communication chips.
- algorithm development for efficient networking and communication methods that enable rapid, ad-hoc networking of any number of microsensors, either fixed in location or mobile.
- algorithm development for collaborative signal and distributed information processing within the network to detect and track events and patterns of events occurring in the network area.

1. C.-Y. Chong, S.P. Kumar, "Sensor networks: evolution, opportunity, and challenges," *Proceedings of the IEEE*, vol. 91, no. 8, Aug. 2003, pp. 1247-1256.

8.2. Mass Communication Research for Detecting and Analyzing Hostile Media Campaigns

POC: Dr. Timothy Thomas, 703-613-8275 (CIA)

The IC, along with its partners in the White House, the Department of State and the DOD, is charged with countering orchestrated, hostile foreign media campaigns that are aimed at preventing the USG from accomplishing its foreign policy objectives. In order to fulfill this mission, it is necessary to detect, dissect, predict, and in general understand how these campaigns are designed, managed, executed and to assess the effectiveness of the various techniques they employ.

Hostile media campaigns are akin to negative political campaigns, aggressive advertising efforts, and marketing aimed at capturing market share from competitors. The techniques and strategies used in these private sector activities have been the focus of much dedicated academic scientific study. The IC seeks to leverage this existing pool of talent and experience to help devise effective techniques for defending our Nation against the negative impact of these centrally planned, funded and executed hostile foreign media campaigns.

Researchers in Mass Communication have at their disposal a host of proven scientific techniques

to facilitate their analyses. These include surveys, focus groups, statistical sampling of the media environment, authorship analysis, content analysis, media analysis, psychological studies, and cultural anthropological research. The USG, and particularly the IC components, have fallen behind in the application of these modern methods.

Proposals are sought in areas such as: stratifying unfamiliar target populations to identify the intended target audience of the campaign being analyzed, determining which levers of influence are being manipulated in particular socio-political situations, uncovering the use of subtle cultural iconography, and collecting meaningful samples of the information environment, uncovering the beliefs and attitudes which make the target susceptible to the hostile message, and measuring the likely impact of particular media events.

8.3. 3D Models from Uncontrolled Video

POC: Mr. Brian A. Keith, 703-874-3810 (CIA)

This proposed Postdoctoral position is to study the applicability and empirical accuracy of automatic 3D shape from uncontrolled video using methods such as those described by Faugeras[1,2], Hartley[3], Pollefeys[4], and Van Gool[5].

Current state-of-the-art commercial photogrammetry packages require manual point identification, camera resection, manual geometric primitive placement in model space, and manual texture assignment. Model production time is measured in weeks or months, and such current long production times prevent 3D models from being used as a standard intelligence tool.

Recent academic papers in the field of computer vision and photogrammetry indicate it is possible to automatically extract textured three-dimensional models from uncontrolled video. Sample models extracted from video, as presented in papers and on the Internet, show high resolution textures, and fine level 3D structure that is cannot be built with current COTS packages. Although the extracted models "look good," there have not been any empirical studies of the geometric and metric accuracy.

We seek proposals to implement the shape from video algorithms to automatically detect and track distinct image points, compute camera orientation and internal geometry, build 3D depth maps, attach texture, and export the result in VRML or MAYA compatible computer files.

Accuracy would be determined by comparing models created by the system to actual measurements made on controlled targets. 3D models created under different collection conditions would be compared to evaluate consistency.

8.4. Improved Compact Energy Storage and Power Generation Devices

POC: Dr. James Beckwith, 703-874-0728 (CIA)

The Intelligence Community needs improved energy storage and power generation methods to satisfy multiple terrestrial and aerospace requirements. Compact size (volume and weight) for expanded energy and power is critical for current and future missions and robust operation at wide temperature extremes (from minus 40 degrees C to over 115 degrees C) is also required. At the same time, long operational time frames are sought: for example, aerospace missions require 10-15 year performance ranges; terrestrial missions for mobile and remote applications require multiple-year operation.

Lithium rechargeable battery chemistries offer considerable promise to meet these often-contradictory needs. At present, the practical specific energy for lithium-ion chemistry is less than 150 Wh/kg range with practical energy density less than 350 Wh/L. In addition, irreversible first cycle capacity losses and capacity fade upon continued cycling impacts the achievable specific energy and energy density, reducing mission life. However, considerable room for improvement exists, given that the theoretical specific energy value is 455 Wh/kg. The postdoctoral candidates are challenged to investigate approaches to expand and enhance lithium rechargeable battery performance in the critical areas identified above. Improvements are needed for the electrodes, solvents, and separators/membranes. Candidates are welcomed to consider other rechargeable chemistries and/or other options that could lead to improved energy/power options.

8.5. Remote Sensing of Concrete Properties

POC: Dr. Warren Philipson, 703-733-9022 (CIA)

There is a long-term critical need to identify and determine key properties of construction materials through remote sensing. Of particular interest is concrete, whose building thickness may range from centimeters to meters, and whose compressive strength may vary by a factor of 10 to 15.

Exploratory lab and test-bay investigations directed by the proposed IC advisor indicate that for a given realistic experimental configuration, observations of the surface temperature of concrete can be used to estimate the compressive strength to within about 1000 pounds per square inch and to categorize thickness as 0.25 meter, 0.5 meter or 1.0 meter and greater.

We are interested in proposals for in-depth investigations involving remote and contact sensors and modeling (e.g., heat transfer) to determine: 1) how better estimates of concrete might be obtained, and 2) under what structural configurations and environmental conditions such estimates are possible. Lab and test-bay observations must be supported by field study.

8.6. Advanced Full Spectrum Methods and Techniques

POC: Mr. Ernie Reith, 703-735-3222 (NGA)

The US Intelligence Community (IC) continues to explore and expand their understanding of non-literal processing, exploitation, and analysis (PEA) capabilities and sources to solve enduring and emerging intelligence problems. These non-literal PEA capabilities and sources need to address multiple applications of IC interest and be robust, user-friendly, highly automated, and reliable. PEA capabilities of interest would include, but not be limited to, non-linear sub-pixel detection and identification, modeling spectral/signature variability, and background-foreground separation. The IC is requesting post-doctoral research in new methods and techniques to derive geospatial intelligence and develop advanced PEA tools from unique sources.

The sources of particular interest include advanced remote sensing data types such as hyperspectral, LIDAR/laser, polarimetric, and synthetic aperture radar (SAR) imagery. Emphasis will be placed on offerers exhibiting unique synergistic PEA methods and techniques utilizing complementary sources yielding high value geospatial intelligence. Exemplar research projects are automatic land surface and mineral mapping applications via spectral library matching of hyperspectral imagery and backscatter modeling of SAR data.

8.7. Biological Principles applied to Geospatial Intelligence Data Fusion

POC: Dr. Jeffrey Kretsch, 703-735-3159 (NGA)

The Intelligence Community is faced with growing demands both in the volume of data to be analyzed, as well as in the sophistication of the information that must be gleaned from multiple data streams. In the context of ever-limited resources, these demands bring into focus several needs that can be met through basic science research.

For example, the high dimensionality (spatial/temporal/spectral) of imagery data implies a need to establish flexible representations that can accommodate new data sources, as they become available. Research in biological vision may offer insight in to these needs. Like all biological systems, vision is designed to operate robustly across a virtually limitless range of input. In many

ways, this is a product of the visual system's hierarchy of flexible representations.

Focused research, including psychophysical experiments and computational modeling and further developing the application of measures of information in vision and the structure on the brain, could reveal the biological principles for such representations. An understanding of these principles may apply to other heterogeneous data sources intrinsic to geospatial intelligence.

8.8. Handwritten Document Image Processing

POC: Dr. Paul Thouin, 703-735-3159 (NSA)

Background:

A significant amount of research and development has been conducted to automatically recognize characters from document images. For English and other Latin scripts, commercial systems exist that achieve more than 99% character accuracy on clean laser-printed images. Software also exists to recognize many other alphabets, such as Arabic and Chinese, with fairly high accuracy on machine-printed documents. As might be expected, the accuracy of automated handwritten character recognition is much lower.

There are only a small number of systems that currently process handwritten document images, and these are very limited in scope. SUNY-Buffalo developed a system to recognize destination addresses on envelopes for the US Postal Service, which has proven to be effective. Several groups have developed systems to process handwritten entries on forms, where numbers are typically written within boxes. In both of these cases, locating and recognizing the handwritten text within the image is greatly simplified by prior knowledge. A somewhat related technique, called "on-line recognition" is performed by hand-held personal digital assistants such as the Palm Pilot. These devices have the significant advantage of temporal keystroke information that greatly improves their recognition. Creating a system to recognize unconstrained handwritten characters from off-line images is an unsolved research problem.

Research Proposal:

The goal of this research is to improve the state-of-the-art for character recognition of off-line, unconstrained, non-Latin handwritten document images. It is not expected that an entire character recognition system will be developed as a result of this research, but that some fundamental breakthrough will be made that will benefit future recognition systems. The research should be cutting-edge original work, and not simply applying an existing technique to

a new problem.

The goal of this proposal is purposefully broad so as not to limit candidate researchers to a single specific problem defined by the mentor, but rather to allow individuals to select a relevant focus where they believe they can potentially have a significant impact. It is required that this research focuses on unconstrained off-line handwritten images in a non-Latin script. It is also strongly preferred that a widely used script such as Arabic or Chinese is selected. Some possible areas of focus include, but are not limited to:

- Character Segmentation - locating text characters, words, and symbols within complex document images; noise removal, such as line suppression from forms; recognizing disjoint strokes as part of the same character, word, or symbol; recognizing separate characters, words, and symbols that are overlapped or connected; and identifying non-text regions.

- Character Recognition – identifying the script of the characters, words, and symbols; recognizing the characters, words, and symbols within the document image; and enhancing characters, words, and symbols to improve recognition.

- Character Clustering – identifying similar characters, words, and symbols within an image; and measuring similarity between different characters or words.

- Feature Extraction – identifying discriminatory features at either the local or global level that can be used to improve character, word, and symbol processing.

An important consideration of any research project is selecting relevant data for evaluation. Fortunately, there already exist a number of non-Latin handwritten image datasets that could be used to evaluate this research. One such source of handwritten Arabic images was created by the Institute for Communications Technology Technical University, Braunschweig, Germany and the Ecole Nationale d'Ingenieur de Tunis (IFN/ENIT), their website is http://www.ifnenit.com/ . The database contains more than 2,200 images written by 411 writers with 26,000 word images, and includes marked ground truth to assist with evaluations.

8.9. Nanostructural Photonics

POC: Dr. Timothy Persons, 301-688-7092 (NSA-ARDA)

The objective of this proposal is to explore the science and technology of nanostructural photonics for IC applications. Indeed, the enhanced functionality of nanophotonic-devices holds great promise for applications such as high-speed optical switching and high sensitivity chemical sensing.

The basic nanophotonics unit consists of nanodots, nanofibers and nanostructures. The nanodot and fibers are for light-emission/amplification/detection and nanostructures for light manipulation and processing. In general, there are two distinct methods for building nano photonic devices. One is the so-called "top-to-down" approach that often involves semiconductor lithographic techniques. This approach is expensive and yet can produces large area structures with few defects. The other is the "bottom-up" approach, which typically relies on self-assembly or programmed assembly techniques. This method is cheaper, yet it's not as easy to build complicated devices over a large area and with little defects. It is also to be noted that a nanophotonic program must invest in nanospectroscopy, as the device size is nanometer in scale.

Under this proposal, the basic nanounits are examined, the two fabrication approaches explored and a new nanospectroscopic tool built. Particularly, a new set of light-emitting nanomaterials, methods for nano-assembling and templating nanodots, and tools for nanospectroscopy have all been developed.

One of two research projects are proposed:

- Nano-crystals and nanofibers for an Enhanced Optical Functionality, which includes the subtopics of:
  - Assembly of nanoclusters on silicon surfaces, and
  - Polymer-based non-linear nanophotonics
- Photonic Crystals and Optical Communications, which includes the subtopics of:
  - Nanocrystal quantum dots as active media for photonic crystal lasers and amplifiers, and
  - Fabrication and testing of nanostructures for photonic crystals.

Applications would be solicited for a postdoctoral research fellowship in experimental or theoretical aspects of the above topics in nanophotonics, with particular emphasis on single-photon source applications. The successful applicant would join an established nanostructures research team and be expected to set up his own project, relevant to and compatible with team interests, under the guidance of and with assistance from senior team members. The objective of the fellowship will be to significantly advance the state-of-the-art in molecular optoelectronics.

8.10. Quantum Key Distribution

POC: Dr. Dean Collins, 301-688-7092 (NSA-ARDA)

Quantum key distribution (QKD) holds tremendous promise as a new tool in the secure communications toolbox, offering greater long-term security assurances and convenience than present-day key distribution methodologies. Potential applications of QKD include: secure satellite command, control and telemetry; transformational communications scenarios; and as an enhancement to the key management infrastructure. In order to realize this potential and to ensure continued US leadership in QKD it is essential to expand the cadre of researchers in this field, which has emerged at the intersection of fundamental quantum optics, information theory and cryptography. To that end we propose that a postdoctoral research fellowship, targeted at specific gaps and opportunities within the US portfolio of QKD activities, should be established. The specific areas of QKD research that the proposed fellowship would target are:

- QKD using entangled light sources over line-of-sight paths. This "second wave" of QKD (as opposed to the "first wave" that is based on attenuated laser light sources) is now poised to emerge from the physics lab and has the potential to offer further security advantages. To take this type of QKD into the field will require research into robust, portable, intense sources of entangled photons and the demonstration of entanglement transmission over multi-kilometer line-of-sight paths in the presence of strong backgrounds.

- End-to-end modeling of QKD systems. There are a mere handful of researchers in the world (and even fewer in the US) who possess the knowledge and expertise relevant to model a complete QKD system. This requires knowledge of and familiarity with: quantum optics; information theory; coding theory; statistical estimation theory; cryptography; atmospheric optics; satellite orbital dynamics; and synchronization, timing and ranging techniques. Deeper understanding of the interplay between these aspects of QKD and overall system performance is essential.

- QKD security engineering. To date the security of QKD has been studied with a strong emphasis on the physics issues involved, but as this subject evolves it will be necessary to develop a security engineering perspective on an entire system. Topics to be developed include: robust authentication architectures for QKD; algorithms for QKD; and QKD to support secure networks.

  Applications would be solicited for a postdoctoral research fellowship in experimental or theoretical aspects of the above topics in quantum key distribution (QKD), with particular emphasis on line-of-sight applications. The successful applicant would join an established QKD research team and be expected to set up his own project, relevant to and compatible with team interests, under the guidance of and with assistance from senior team members. The objective of the fellowship will be to significantly advance the state-of-the-art in QKD.

8.11. Statistical Structure of the Ionosphere

POC: Dr. Davidson Chen, 703-808-4916 (NRO)

Background: Over the past 5 years, the Office of the Secretary of Defense has sponsored basic research to develop observing technology and analysis techniques to enable space weather forecasting. Funding was provided under the Multi-Disciplinary University Research Initiative (MURI) Program. This project, known as *Global Assimilation of Ionospheric Measurements* (or GAIM), is jointly managed by the Office of Naval Research and Air Force Office of Scientific Research. GAIM research has centered on representing the physics of the ionosphere and exploiting multiple sensing technologies (existing, new, ground and space-based sensors) in order to determine, then forecast, the structure of the ionosphere. Two university project teams have been developing this technology. GAIM is scheduled for completion in fiscal year 2004. When completed, the GAIM capability will represent a revolutionary change from traditional climatological models of the ionosphere and will have significant scientific and operational impacts.

Proposed Research Topic: At the heart of GAIM development is a sophisticated, computational complex estimation technique (utilizing a Kalman filter) that minimizes a cost function composed of both current ionospheric observations related to the electron density and a background field of electron density provided by the latest prior forecast.

Effective utilization of these developments will require an understanding of the statistical properties (e.g. correlation lengths or times) of the global electron distribution of the ionosphere. As a dynamic process the statistical properties of the ionosphere are spatial and temporal in nature as well as dependent on multiple geophysical parameters. Accurate knowledge of the statistical properties of the ionosphere will be critical for optimal utilization of the GAIM estimation process. MURI funding limitations did not allow for research into the statistical nature of the ionosphere. Thus, near-term forecasting with GAIM will utilize empirical assessments (limited to perhaps engineering judgment) of these statistical properties.

The post-doctoral research under the DCI Fellowship Program will be directed toward developing rigorous methods for representing the statistical properties of the ionosphere. This research will directly enhance the use of GAIM technology in both civilian and defense applications. Precise ionospheric forecasting would result in improved support to Global Positioning System navigation users (single frequency applications), improve the capability to predict communication outages, and optimize radio frequency propagation techniques, as well as improve other applications where ionospheric effects have critical performance impacts.

8.12. (Topic Withdrawn)

8.13. Meta-Materials for Antennas

POC: Dr. George Dumais, 703-874-3293 (ITIC)

The engineering of materials with novel electromagenetic properties has made significant advances in recent years. In particular the emergence of a class of materials referred to generally as metamaterials has shown considerable promise in the area of antenna performance, opening up new possibilities for controlling the bandwidth and gain of antenna elements, as well as their size, shape, and weight. The purpose of this postdoctoral effort would be to further the theoretical and practical understanding of the use of these materials in controlling antenna characteristics.

Research would be conducted on methods for exploiting the novel electromagnetic properties of so-called 'left-handed', or other metamaterials, in the design and fabrication of antenna structures so as to increase the gain and/or bandwidth of antennas and antenna arrays. Investigation of both materials design issues as well as fabrication techniques should be carried out. Development of computerized models and methodologies for evaluating antenna structure design tradeoffs and predicting expected performance should be undertaken. Attention should be given to both receive-only as well as transmit and receive antenna structures.

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8.14. Nanotubes and Organic Conductors for High-Performance

POC: Marty Carr, 703-874-0694 (ITIC)

Organic thin film electronics hold the promise of allowing electronic devices to be imbedded in almost any substrate, flat or curved, opaque or transparent, rigid or bendable, leading to applications in flexible, wearable and/or disposable electronics. The current technology for such electronic devices uses thin films of organic conductors and semiconductors, such as PEDOT:PSS, pentacene and sexithiophene. However, the electrical properties of these materials are quite poor: the conductivity of the organic conductors is generally on order 1 Ohm/cm (six orders of magnitude worse than good metals such as copper or gold), and the carrier mobility in the organic semiconductors rarely exceeds 1 cm^2/Vs (compared to several hundred cm^2/Vs for silicon) and is often much lower. As a result, organic electronics are currently limited to very low speed applications, e.g. displays.

An intriguing possibility is the integration of nanotubes with conducting and

semiconducting organic materials in order to form high-speed, low-voltage devices and high conductance interconnects within flexible thin film electronic materials. Carbon nanotubes, nanometer-diameter wires of pure carbon that may be metallic or semiconducting, could revolutionize flexible/wearable/disposable electronics. The conductivity of metallic carbon nanotubes is comparable to that of good metals, and the mobility in semiconducting nanotubes exceeds 100,000 cm^2/Vs at room temperature, higher than any other known semiconductor. Disordered networks of metallic and semiconducting nanotubes have been shown to have effect mobilities of 10-100 cm^2/Vs, and such networks have been transferred to flexible substrates. Such devices would significantly enhance the applicability of flexible electronics in areas requiring high-speed computation or high-frequency communication, and will also reduce the power consumption of such devices – crucial for ubiquitous computing..

8.15. Fluorescent nano-particles for high efficiency sensors

POC: Marty Carr 703-874-0694 (ITIC)

There is considerable interest at present in developing highly efficient fluorescence-based sensors, which might be used in the detection of very small levels of certain proteins or DNA. Labeling of enzymes or complimentary strands of DNA with fluorescent dyes or "fluorophores" has the advantage of selectivity for a particular target molecule or agent, however achieving the desired level of sensitivity, making the realization of practical field-based, real-time detection systems technically challenging. Photobleaching irreversibly deactivates fluorophores at too large an incident light intensity setting a limit to the signal achievable by merely illuminating the sensor with a very bright source. Background signal and signal-to-noise considerations on the other hand limit the efficacy of amplifying a very weak fluorescent signal optoelectronically.

An appealing candidate technique for overcoming these limitations is metal-enhanced fluorescence (MEF), also referred to a surface enhanced fluorescence (SEF). It is observed that the ratio of the fluorescently emitted photon intensity to the incident intensity is enhanced if the fluorophores are in close proximity to certain metal particles of nanometer-scale dimensions. Measurements indicate that proximity of fluorophores to nano-particles produces increased fluorescent intensity and quantum yield while reducing the fluorescent lifetime. These effects combine to increase the photostability of the molecules, a desirable effect in a sensor application. Possible applications include improved portable sensors for bio-hazards.

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8.16. Organic Electronic Transport in Confined Dimensions

POC: Marty Carr 703-874-0694 (ITIC)

Interfacing the power of electronic processing with the sensing capabilities, biological compatibility, and potential for nanoscale device sizes of novel electronic materials inevitably requires dealing with issues of self assembly and control of interface properties. Organic electronic materials have both the capability of interfacing to traditional Si-based electronics, and the potential for directed assembly via chemical functionalization of their molecular basis.

We are interested in novel assembly mechanisms for patterning organic electronic circuits, such as the use of functionalized molecules designed for specific attachment sites, or for the attachment of additional materials. These additional materials may be other layers in circuit architecture, or molecular or biological species targeted for sensing by the organic electronic circuitry. Patterning technologies might include new and innovating techniques such as nano-imprint or templates made from nanoporous membranes.

8.17. Nano- to Micro-Scale Power Sources

POC: Marty Carr 703-874-0694 (ITIC)
Enoch Wang 703-874-1726

The development and implementation of distributed sensing and communications technology, as well as other portable electronics of military and intelligence interests, has to a large extent been limited by the power source. The goal of the project is to develop nano- to micro-scale power sources that are capable of being coupled with energy harvesting technologies for long-term power and energy needs. Power sources other than electrochemical cells are preferred. Of specific interest is the development of micro-fuel cells, micro-photovoltaic cells and micro-thermoelectric cells. Proposals are sought for the development of new designs and fabrication approaches that, in conjunction with energy harvesting techniques, can provide rechargeable power under extreme conditions in a wide variety of form factors and size scales. The proposed power source should be capable of providing power in the range of few miliwatts for one year at temperatures between -40C and +70C. The size scales of interest range from active footprints and volumes of 10 nm x 10 nm and 10-5 um3, up to 4 mm2 and 8 mm3.

8.18. Discovering Pathogen Signatures Of Genetic Modification Associated With Virulence Factors, Toxins, And Antibiotic Resistance

POC: Ronald Walters 703-874-0696 (ITIC)

The "Attribution Studies and Analysis" component of the ITIC Counter BW Program is charged with delivering capabilities for pathogen bioforensics for purposes of attribution. While a number of methods can be used for pathogen detection and characterization, DNA analyses are (and for some time will remain) the most sensitive and versatile forensic assay. With high throughput DNA sequencing readily available to the scientific community, pathogen genomes can be sequenced very rapidly and quite inexpensively. However, sequences are virtually worthless in the absence of the bioinformatics capabilities to analyze the data.

ITIC is supporting the LLNL bioinformatics team to develop procedures that will be used to determine the amount of genomic sequencing necessary to acquire high-quality diagnostic and forensic DNA (and protein) signatures. The capabilities developed in this program can be readily and rapidly extended and applied to comparative genomics studies. Current assays provide a signal that indicates only the presence or absence of specific biothreat agents. Distinct advantages can be gained if additional information can be rapidly acquired regarding evidence of genetic engineering, presence of virulence factors, antibiotic resistance, and toxins.

This project requests support for a postdoctoral fellow who will use computational tools to discover signatures for detecting evidence of genetic modifications and possible associations with virulence factors, toxins, and antibiotic resistance.

8.19. Improving the Ease of Use of Iris Recognition Biometric Systems

POC: Andrew Kirby 703-874-0834 (ITIC)

Biometrics-based authentication and identification systems (BAIS) are being implemented at an increasing rate in government and industry for many different security applications such as authentication and/or identification. However, such systems have yet to gain widespread use owing to various limitations in their intended applications such as reliability and ease of use. Iris recognition (IR) is said by many to be potentially the most reliable biometric, yet IR can be vastly improved in terms of ease enrollment and verification. In addition, only one IR algorithm has been commercialized to any extent whereas face recognition systems have enjoyed the benefit of many competing approaches.

The sponsor is particularly interested in improving many aspects of the performance of

today's IR systems. However, we highlight the following limitations:

Enrollment range (limited to 18 to 30 inches)

Time required for successful enrollment (can be minutes)

Time necessary to acquire an image for verification (10s of seconds)

Processing of raw image data (limited to low resolution and some data discarded)

Lack of use of state of the art imaging arrays

The primary objectives the proposed research must be among the following:

1. Examine the key means to improve iris recognition systems in terms of ease of enrollment, ease of verification (both authentication and identification).
2. Propose and demonstrate effective means to acquire iris images at ranges of about two meters with minimal inconvenience to the subject being imaged.
3. Objectively evaluate the performance of the three or so leading iris recognition algorithms against a standard set of raw iris images.
4. Develop and demonstrate improved or alternative iris recognition algorithms that afford ease of use advantages and/or other performance advantages.
5. Develop and demonstrate successful hardware and software implementations of iris recognition systems with vastly improved ease of use.

Given the complexity of implementing an entire biometric system, the proposer is free to focus on any subset of the above objectives. Proposals will be judged in terms of their innovativeness and whether they represent realistic and reasonably achievable goalshere.

8.20. How Can Condition-Based Maintenance Teach Us How to Build More Robust Robots?

POC: Gregory Moore 703-874-0831 (ITIC)

One of the problems with robots is that they break, and often at the most inconvenient time. Ideally, one would like to know that they are about to break, rather than that they have broken. An entire field (conditioned based maintenance) uses predictive tools and in-situ measurements

to determine when maintenance should be performed on machinery. How can this field and related methods lead to more robust operation of small mobile robots?

A simple example of how this might apply is a robot capable of traveling on land and in water. After the robot has sustained a long and bumpy traverse on land, the operator of this system would like to know whether it is still waterproof before guiding the system into the water. By pressurizing the electronics bay, one could tell if the electronics bay was still watertight, beginning to leak, or completely breached. With this knowledge, the operator might choose to take an alternate path rather than risk electrical shorting and failure of the platform in the water.

We seek proposals that explore the practical approaches and limits of this general idea, particularly from a multidisciplinary perspective. Eventually, these robots could become self-monitoring. Such a capability might be achieved by measuring a component property directly, by using change detection methods to examine performance anomalies, or some combination of these methods. At some point, systems with high levels of autonomy might even adopt strategies to delay failure or repair damage.

8.21. Countering Pathogen Virulence

POC: Norm Kahn 703-874-4927 (ITIC)
Janet Dorigan 703-918-9672

Objective:

Initiate a creative training program that will provide a cadre of scientists capable of developing and implementing countermeasures against the harmful effects of microbial pathogens.

There exists a critical need to block the harmful effects of microbial pathogens whether they are found in food, animals, or humans - or are used in terrorism incidents. In order to counter the effects of virulence, an understanding of the microbe, its target host, and the interaction of these two are required. This requires an interdisciplinary approach that incorporates molecular biology to understand the virulence factors with epidemiological expertise to identify environmental and host influences. Central to achieving this broad awareness of pathogenicity is establishing and maintaining a cadre of investigators who will not only be available today but will also engage and train the next generation of researchers. Creative training programs will help achieve this goal.

Background: Identification of Pathogen Virulence Factors and Countermeasures

In order to block the deleterious effects of a pathogen, it is useful to identify its virulence

factors as well as the vulnerabilities of the target (human, animal, plant, or materiel). It is also important to understand the interaction between the pathogen and the target. Even beyond this, rational countermeasures should take into account practical real-world issues. Often countermeasures could be employed that block the deleterious effect partially, or for a period of time, until a second series of countermeasures can be employed. This strategy is analogous to the situation of a cardiac arrest outside the hospital. A prompt response of CPR can sustain life until the patient arrives at the hospital. There, clot dissolving medication or coronary artery bypass surgery can provide the more permanent life saving measures. Perfection is an ideal goal, but often-critical time can be saved by using measures that are expedient but sufficient. This requires use of knowledge, data, and experience to devise and affect strategies.

Training a new cadre of researchers is critical not only to maintain investigation of interaction of pathogen and host or target but also to do so in the context of feasible solutions with innovation approaches, or even old ones, so long as they lead to the needed solution. An institution is required that has the capability to provide the opportunity for such training in the area of microbial virulence factors, host vulnerabilities, and the interactions in order to reduce the harmful effects. Along with the science, access to the intelligence community is necessary so that trainees will have an opportunity to see how intelligence information and thinking can help tailor their approach within a multitude of possible avenues. This can lead to effective planning and design of experiments that produce applicable results within a useful time period.

Capabilities required:

Some of the experience that is desirable at the training institution is:

- In-depth study of biothreat pathogens and vector-borne disease pathogens.
- Experience with testing multiple strains of a pathogen in natural hosts to provide a phenotypic characterization of each strain, including virulence and avirulence.
- Characterization of virulence as it is expressed within a natural host and impacted by all its selection factors.
- Whole genomic sequencing and comparative genomics for identifying nucleotide differences that may account for the variability in virulence factors - important to further investigation into countermeasures.
- Proteomics to analyze complementary or convergent data with respect to expression of products from the genes. This may be an important area as it may not be the absence of a gene or product that turns a strain into an avirulent (or virulent) one but it could be the presence of a product that activates the host response to protect itself.

The trainee should learn methodology that includes genomic sequencing and bioinformatics analysis, mass spectrometry and peptide mapping, and traditional microbiological methods. He or she should rotate in specialized laboratories as appropriate, including epidemiological facilities. As the individual will be exposed to traditional scientific seminars, opportunities should be afforded to attend those conferences and discussions where the intelligence perspective can be included with traditional scientific disciplineshere.

8.22. Inversion of Undersampled, Noisy, Ambiguous Data" Selection and Qualification of Concluding Hypotheses

POC: Daniel Cress 703-874-0700 (ITIC)

There is a strong need for the development of generalized techniques for selecting leading hypotheses drawn from less-than-complete data sets while maintaining measures of uncertainty due to ambiguous and noisy data. Equally important to the data sets are display tools to aid visualization of the relative strength of the hypotheses, ambiguities, and the most sensitive parameters. Preferably, two types of cases will be considered: (1) the physics-based source-to-observable case for which forward (predictive) models can be well defined, and (2) linkage-based source-to-observable case for which the only driving conditions are the presence of a linkage or not, the "time constant" in establishing or relaying the linkage, and multiple potential linkage paths. An example data set for the first would be the observation of air sample concentrations over time at a few locations and inversion to locate the most likely source locations (multiple solutions may be available). An example of the second would be propagation of a disease due to direct contacts with the observation being the number of reported illnesses as a function of time at multiple infirmaries – what was the most likely linkage path and, coincidentally, where was the most likely origin?

The objectives are: (1) to incorporate statistical variability into the observables, including likely background noise, to infer the relative strength and uncertainty for each of several candidate hypotheses, and (2) identify effective visualizations for relaying the results to other analysts and to management. Keys in the inversion process include statistical variation of inputs and for source-observable paths to express the level of unknowns, identification of the parameters that most strongly impact the hypotheses (sensitivity analysis), and display of strength of hypotheses and ambiguities.

8.23. Cross-Domain Monitoring of Activities of Non-State Individuals and Organizations

POC: Susan Durham 703-874-4264 (ITIC)

We are in an era where individuals and small relatively small groups of non-state sponsored actors are having tremendous impact on the political decisions of nations around the world. Terrorist leaders and their organizations are prominent among these influential entities. Identifying, monitoring and predicting activities of such loosely organized but highly motivated, focused and agile groups is a great challenge.

However, certain civil, academic and commercial organizations have long had similar challenges to keep abreast of the movements, attitudes, communications and potential activities of groups of interest to them. For example, civil "watchdog" groups monitor activities of commercial industries, such as environmentalist groups monitoring the whaling or forestry industries. Similarly, commercial entities monitor the habits of their customers and competitors within their industry. Members of the news media continually assess the interests, responses and activities of both subjects in the news and those who watch the news. Academics often study cognitive and social behaviors of groups not only using traditional control groups, but also by using observed patterns of activities of groups at large in uncontrolled environments. The tools used by these "watchers" to continuously update their understanding of the current state of those they "watch" vary widely. They range from the monitoring of physical activities (e.g. movements), social behaviors (e.g. formation and disbanding of partnerships) and information sharing habits (e.g. Internet use), and are often used in combination.

The intent of this effort is to investigate the potential use of the various tools and methods used by civil, commercial and academic communities, across physical, behavioral and information-oriented domains, to monitor and potentially predict behaviors of terrorist organizations. It is hoped that these "non-traditional" methods -- non-traditional in context of the Intelligence Community (IC) -- may be adapted for IC use in monitoring activities of terrorists. The best result of this activity would the identification, testing and validation of, heretofore, under-exploited tools and methods, that span the physical, behavioral and information domains.

8.24. Novel Applications of Quantum Entangled Photons for the Information Gathering

POC: Susan Durham 703-874-4264 (ITIC)

The theory of quantum entanglement -- the intrinsic correlation of physical properties of pairs of photons over distance -- has been studied since the 1930's. But it has only been in the recent

dozen years or so that efforts to develop practical applications exploiting this phenomenon have come to the forefront. The vast majority of efforts focus primarily on quantum computing and quantum cryptography. However there are many other potential applications of harnessing the unique properties of entangled photons -- such as remote sensing, teleportation, spectroscopy, lithography and imaging, to name a few -- which have potential use for information gathering and yet are not well developed theoretically or fully validated experimentally. The intent of this effort is to investigate these possibly under-exploited opportunities for information gathering, to quantify the potential benefits and, if warranted, to engage in experimentation to realize these opportunities.

This effort could be approached in one of two ways. The investigator may conduct a comprehensive survey of existing and hypothesized applications of entanglement science and, with the assistance of the PI and IC advisor, down select to a subset for intense study and experiment definition, with the potential of conducting select experiments in the future. Alternatively, an investigator could propose a specific application that he/she is currently investigating and that meet the criterion above, quantify the utility of the application for information gathering and design appropriate experimental validation of the assumed utility. Further experimentation is possible, if warranted.

9. SIGNIFICANT DATES

The following table provides the significant dates referred to in the body of this announcement.

Action		**Est Date**
Issue announcement		12 February 2004
Proposal due		12 March 2004
Acknowledge receipt of proposals		15 March 2004
Letter of intent to recommend for award		30 April 2004
Estimated Start date		3 May 2004
DCI Postdoctoral Colloquium (required attendance)		6-8 April 2005

9.1. Late Submissions

Proposals will be considered for award if submitted timely. If a proposal is

submitted in an untimely manner, after 3:00 P.M. (Eastern Daylight Savings Time) on, 04 March 2004 the criteria in Federal Acquisition Regulation part 15.208 will be adhered.

POINTS OF CONTACT

9.2. Grants and Contracting

Ms. Denise Wood at 703 735-3023.

9.3. Technical Issues

Mr. Scott Loomer at 703-735-3062

Mr. Tom Kennedy at 703-874-0689